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MEMORANDUM

DATE: July 26, 2011

TO: Renee Nordeen, Project Manager, Ecology and Environment, Inc., Seattle, WA

FROM: Cameron Fisher, Fisheries Biologist, Ecology and Environment, Inc., Seattle, WA

SUBJ: TDD: 10-11-0007 presence of salmonoid species

Two salmonid species, steelhead (*Oncorhynchus mykiss*) and Chinook salmon (*O. tshawytscha*), are federally listed under the ESA as threatened and are likely to occur within the target distance limit (TDL). Within the TDL is the Zone of Actual Contamination (see attached figure). The two listed salmonid species would occur in the Zone of Actual Contamination during daily high tide, and possibly during daily neap low tides.

The National Marine Fisheries Service listed the coastal steelhead Evolutionary Significant Unit (ESU) in Puget Sound as threatened in 2007 (Federal Registry 2007). The Puget Sound Chinook salmon ESU was listed as threatened in 1999 (Federal Registry 1999), with the threatened listing reaffirmed in 2005 (Good 2005). Critical habitat was designated for Puget Sound Chinook shortly thereafter in 2005 (Federal Registry 2005) (Table 1).

Table 1: Salmonids and critical Habitat Likely to Occur Within the TDL

Water Body	Species	Federal Status	Critical Habitat
Puget Sound	Chinook Salmon – Puget Sound ESU	Threatened	Yes
	Steelhead – Puget Sound ESU	Threatened	No

Steelhead exhibits the most complex life history of any species of Pacific salmon. Steelhead can be freshwater residents (referred to as “rainbow trout”) or anadromous (referred to as “steelhead”). Anadromous forms spend up to 1 to 3 years in fresh water prior to smoltification and then spend up to 3 years in salt water prior to migrating back to their natal streams to spawn (Hard et al. 2007). In addition, steelhead may spawn more than once during their life span, whereas other Pacific salmon species, such as Chinook salmon rear in freshwater, migrate to the ocean for 3 to 5 years before returning to their natal streams to spawn and die.

Coastal steelhead ESU in Puget Sound occupies river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. Included are river basins as far west as the Elwha River and as far north as the Nooksack River. As the anadromous form of rainbow trout, this species not only utilizes freshwater drainages, but also the waters of Puget Sound during migration. When steelhead migrate to the ocean, they may spend considerable time as both juveniles and adults in the marine environment of Puget Sound (Busby et al. 1996).

Chinook smolts (juveniles that have transitioned from fresh water to salt water) usually migrate to estuarine areas within the first year, approximately 3 months after emergence from spawning gravel. It is during this time they depend on the nearshore habitats for foraging and refuge. The nearshore includes the intertidal area and marine waters that extend landward to the Mean Higher High Water Mark. Chinook salmon typically leave estuaries in the late spring months and according to Fresh (2006) “*Once juvenile Chinook salmon leave estuarine/delta habitats and enter Puget Sound, they distribute widely and probably can be found along all stretches of shoreline at some point during the year.*”

Reference

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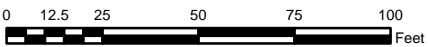
Base Map Reference:
Anchor QEA, LLC, January 2011, Completion Report, Former Bremerton MPG Site, Incident Action and Time Critical Removal Action, prepared for U.S. Coast Guard Sector Puget Sound Incident Management Division, prepared on behalf of Cascade Natural Gas Corporation, Ref. 4, p. 25.

Map Source Information:
Average High Water Mark: Washington State Department of Ecology (<http://www.ecy.wa.gov/services/gis/data/shore/shore.htm>)
Former Bremerton Gasworks Property Boundary: Kitsap County Geographical Information System. Parcel base map showing tax ownership, major roads and highways, and Public Land Survey Section boundaries. (<http://www.kitsapgov.com/gis/maplibrary>)
Base Map Imagery Source: The map features i-cubed Nationwide Prime 1m or better resolution imagery for the contiguous United States. (http://goto.arcgisonline.com/maps/World_Imagery)

- | | |
|-------------------------------------|---|
| ⊗ Probable Point of Entry (PPE) | — Zone of Actual Contamination |
| ● ERA Sediment Sample Locations | --- Average High Water Mark |
| ▲ TBA Sediment Sample Locations | — 12-inch Concrete Pipe |
| Acronyms | --- Former Bremerton Gasworks Property Boundary |
| TBA Targeted Brownfields Assessment | |
| ERA Emergency Removal Action | |
| MGP Manufacturing Gas Plant | |

BREMERTON GASWORKS
ERA and TBA Sediment Sample Locations

Bremerton Gasworks
Zone of Actual Contamination
Reference 10





Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California

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August 1996

U.S. DEPARTMENT OF COMMERCE

Michael Kantor, Secretary

National Oceanic and Atmospheric Administration

D. James Baker, Administrator

National Marine Fisheries Service

Rolland A. Schmitten, Assistant Administrator for Fisheries

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The Puget Sound region is in the rain shadow of the Olympic Mountains and therefore is drier than the Olympic Peninsula; most of the Puget Sound region averages less than 160 cm of precipitation annually, while most areas of the Olympic Peninsula exceed 240 cm (Jackson 1993). Climate and river hydrology change west of the Elwha River (see Weitkamp et al. 1995). The rivers in Puget Sound generally have high relief in the headwaters and extensive alluvial floodplains in the lowlands. Geology and topography are dominated by the effects of the Cordilleran Ice Sheet as evidenced by glacial deposits and the regional geomorphology.

Puget Sound's fjord-like structure may affect steelhead migration patterns; for example, some populations of coho and chinook salmon, at least historically, remained within Puget Sound and did not migrate to the Pacific Ocean itself (Wright 1968, Williams et al. 1975, Healey 1980). Even when Puget Sound steelhead migrate to the high seas, they may spend considerable time as juveniles or adults in the protected marine environment of Puget Sound, a feature not readily accessible to steelhead from other ESUs.

Most of the life history information for this ESU is from winter-run fish. Apart from the difference with Canadian populations noted above, life history attributes of steelhead within this ESU (migration and spawn timing, smolt age, ocean age, and total age at first spawning) appear to be similar to those of other west coast steelhead. Ocean age for Puget Sound summer steelhead varies among populations; for example, summer steelhead in Deer Creek (North Fork Stillaguamish River Basin) are predominately age-1-ocean, while those in the Tolt River (Snoqualmie River Basin) are most commonly age-3-ocean (WDF et al. 1993).

The Puget Sound ESU includes two stocks that have attracted considerable public attention recently: Deer Creek summer steelhead (North Fork Stillaguamish River Basin) and Lake Washington winter steelhead. Deer Creek summer steelhead were petitioned for listing under the ESA (Washington Trout 1993), but NMFS determined that this population did not by itself represent an ESU (NMFS 1994b). Adult Lake Washington winter steelhead have experienced a high rate of predation by California sea lions (*Zalophus californianus*) below the fish ladder at Hiram M. Chittenden Locks (also known as the Ballard Locks), the artificial outlet of Lake Washington. Deer Creek summer steelhead and Lake Washington winter steelhead were 2 of the 178 stocks identified in the west coast steelhead petition (ONRC et al. 1994).

This ESU is primarily composed of winter steelhead but includes several stocks of summer steelhead, usually in subbasins of large river systems and above seasonal hydrologic barriers. Nonanadromous *O. mykiss* co-occur with the anadromous form in the Puget Sound region; however, the relationship between these forms in this geographic area is unclear.

2) Olympic Peninsula--This coastal steelhead ESU occupies river basins of the Olympic Peninsula, Washington west of the Elwha River and south to, but not including, the rivers that flow into Grays Harbor.

Genetic data collected by WDFW support the hypothesis that, as a group, steelhead populations from the Olympic Peninsula are substantially isolated from those in other regions

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 223

[Docket No. 070123015-7086-02; I.D. 031006D]

RIN 0648-AU43

Endangered and Threatened Species:
Final Listing Determination for Puget
Sound Steelhead

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Final rule.

SUMMARY: We, NMFS, are issuing a final determination to list the distinct population segment (DPS) of steelhead (*Oncorhynchus mykiss*) in Puget Sound, Washington, as a threatened species under the Endangered Species Act (ESA). We intend to issue final protective regulations and propose critical habitat for this DPS in separate rulemakings.

DATES: The effective date of this rule is June 11, 2007.

ADDRESSES: NMFS, Protected Resources Division, 1201 NE Lloyd Boulevard, Suite 1100, Portland, OR 97232.

FOR FURTHER INFORMATION CONTACT: Steve Stone, NMFS, Northwest Region, at (503) 231-2317; or Marta Nammack, NMFS, Office of Protected Resources, at (301) 713 1401. Reference materials regarding these determinations are available upon request or on the Internet at <http://www.nwr.noaa.gov>.

SUPPLEMENTARY INFORMATION:**Background***Steelhead Life History*

Steelhead is the name commonly applied to the anadromous form of the biological species *O. mykiss*. The present distribution of steelhead extends from Kamchatka in Asia, east to Alaska, and south along the Pacific coast to the U.S.-Mexico border (Busby *et al.*, 1996; 67 FR 21586; May 1, 2002). *O. mykiss* exhibit the most complex life-history of any species of Pacific salmonid. *O. mykiss* can be anadromous ("steelhead") or freshwater residents ("rainbow" or "redband" trout), and under some circumstances, they can yield offspring of the alternate life-history form. Anadromous *O. mykiss* can spend up to 7 years in fresh water prior to smoltification (the physiological and behavioral changes required for the transition to salt water), and then spend

up to 3 years in salt water prior to migrating back to their natal streams to spawn. *O. mykiss* may spawn more than once during their life span (iteroparous), whereas the Pacific salmon species generally spawn once and die (semelparous).

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. In a given river basin there may be one or more peaks in migration activity, and these "runs" are usually named for the season in which the peak occurs (e.g., winter, spring, summer, or fall steelhead). Steelhead can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner *et al.*, 1992). The summer or "stream-maturing" type enters fresh water in a sexually immature condition between May and October, and requires several months to mature and spawn. The winter or "ocean-maturing" type enters fresh water between November and April with well-developed gonads and spawns shortly thereafter. In basins with both summer and winter steelhead runs, the summer run generally occurs where habitat is not fully utilized by the winter run, or where an ephemeral hydrologic barrier separates them, such as a seasonal velocity barrier at a waterfall. Summer steelhead usually spawn farther upstream than winter steelhead (Withler, 1966; Roelofs, 1983; Behnke, 1992).

The Puget Sound steelhead DPS includes more than 50 stocks of summer- and winter-run fish, the latter being the most widespread and numerous of the two run types (Washington Department of Fish and Wildlife (WDFW), 2002). Hatchery steelhead production in Puget Sound is widespread and focused primarily on the propagation of winter-run fish derived from a stock of domesticated, mixed-origin steelhead (the Chambers Creek Hatchery stock) originally native to a small Puget Sound stream that is now extirpated from the wild. Hatchery summer-run steelhead are also produced in Puget Sound; these fish are derived from the Skamania River in the Columbia River Basin. The majority of hatchery stocks are not considered part of this DPS because they are more than moderately diverged from the local native populations (NMFS, 2005). Resident *O. mykiss* occur within the range of Puget Sound steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral

characteristics (71 FR 15666; March 29, 2006).

Listing Determinations Under the ESA

We exercise ESA jurisdiction over most marine and anadromous fishes, and are responsible for determining whether West Coast salmon and steelhead warrant listing as threatened or endangered species under the ESA (16 U.S.C. 1531 *et seq.*). Section 3 of the ESA defines "species" as including "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." The term "distinct population segment" is not recognized in the scientific literature. On February 7, 1996, we and the U.S. Fish and Wildlife Service adopted a joint policy for recognizing DPSs under the ESA (DPS Policy; 61 FR 4722). As described in our proposed rule (71 FR 15666; March 29, 2006), we apply the DPS policy in delineating species of West Coast *O. mykiss* for consideration under the ESA. The policy adopts criteria for determining when a group of vertebrates constitutes a DPS: the group must be discrete from other populations and it must be significant to its taxon. A group of organisms is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors." Significance is evaluated with respect to the taxon (species or subspecies). See 70 FR 67132 (November 4, 2005; "Proposed Evaluation of Significance under the DPS Policy"), and 71 FR 836 (January 5, 2006; "General Comments on the Consideration of Resident *O. Mykiss*: Determination of Species")

On June 28, 2005, we published a new policy for the consideration of hatchery-origin fish in ESA listing determinations ("Hatchery Listing Policy;" 70 FR 37204). Under the Hatchery Listing Policy, hatchery stocks are considered part of a DPS if they exhibit a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the DPS (70 FR at 37215; June 28, 2005). If a DPS as a whole warrants listing as threatened or endangered, the hatchery stocks considered part of the DPS will be included in the listing determination.

The ESA requires us to determine whether any species is endangered or threatened because of any of the following five factors: (1) The present or threatened destruction, modification or curtailment of its habitat or range; (2)

overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; or (5) other natural or manmade factors affecting its continued existence (section 4(a)(1)(A)-(E)). The ESA defines an endangered species as one that is in danger of extinction throughout all or a significant portion of its range, and a threatened species as one that is likely to become endangered in the foreseeable future throughout all or a significant portion of its range. We are to make ESA listing determinations based solely on the best available scientific information after conducting a review of the status of the species and taking into account any efforts being made by states or foreign governments to protect the species.

When evaluating the ESA section 4(a)(1) factors we focus on whether and to what extent a given factor represents a threat to the future survival of the species. When we consider protective efforts we assess whether and to what extent they address the identified threats and so ameliorate a species' risk of extinction. The overall steps we follow in implementing this statutory scheme are to: (1) delineate the species under consideration; (2) review the status of the species; (3) consider the ESA section 4(a)(1) factors to identify threats facing the species; (4) assess whether certain protective efforts mitigate these threats; and (5) predict the species' future persistence.

As noted above, as part of our listing determinations we must consider efforts being made to protect a species, and whether these efforts ameliorate the threats facing the species and reduce risks to its survival. Some protective efforts may be fully implemented, and empirical information may be available demonstrating their level of effectiveness in conserving the species. Other protective efforts are new, not yet implemented, or have not demonstrated effectiveness. We evaluate such efforts using the criteria outlined in the Policy for Evaluating Conservation Efforts ("PECE"; 68 FR 15100; March 28, 2003) to determine their certainty of implementation and effectiveness.

Previous ESA Reviews and Findings

In 1996 we reviewed the status of West Coast steelhead. As part of this review we determined that steelhead in Puget Sound did not warrant listing under the ESA (61 FR 41541; August 9, 1996). Subsequently we received and accepted a petition to re-evaluate the status of Puget Sound steelhead (70 FR 17223; April 5, 2005). We reviewed the new information and on March 29,

2006, published a proposed rule to list the Puget Sound steelhead DPS as threatened under the ESA (71 FR 15666). The DPS was proposed to include all naturally spawned anadromous winter-run and summer-run steelhead populations, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks. This proposal was informed by the conclusions of scientists on the Biological Review Team (BRT) who assessed the overall viability of this DPS. Based on this assessment, the BRT concluded that Puget Sound steelhead are likely to become endangered within the foreseeable future throughout all of their range. We also concluded that, at present, protective efforts in Puget Sound do not substantially mitigate the factors threatening the DPS's future viability, nor do they ameliorate the BRT's assessment of extinction risk. Additional details pertaining to these findings and the information reviewed for this DPS can be found in the documents cited above as well as agency status reviews (Busby *et al.*, 1996; NMFS, 2005).

On February 7, 2007 (72 FR 5648), we proposed to issue protective regulations for Puget Sound steelhead under section 4(d) of the ESA. For species listed as threatened, section 4(d) of the ESA requires the Secretary of Commerce (Secretary) to issue such regulations as are deemed necessary and advisable to provide for the conservation of the species. Such 4(d) protective regulations may prohibit, with respect to threatened species, some or all of the acts that section 9(a) of the ESA prohibits with respect to endangered species. Both the section 9(a) prohibitions and section 4(d) regulations apply to all individuals, organizations, and agencies subject to U.S. jurisdiction. The 4(d) regulations we proposed are contingent on a final listing decision, and any finalized 4(d) rule may prohibit the take of Puget Sound steelhead except for specified categories of activities determined to be adequately protective of these fish.

Summary of Comments Received in Response to the Proposed Rule

We solicited public comment on the proposed listing of Puget Sound steelhead for a total of 238 days and held one public hearing in Seattle, Washington (71 FR 15666, March 29, 2006; 71 FR 28294, May 16, 2006). We also sought technical review of the

scientific information underlying the proposed listing determination from seven independent experts. In response to the proposed listing we received over 30 comments by fax, standard mail, and e-mail. The majority of comments received were from interested individuals who submitted e-mails or letters. Comments were also submitted by federal, state and tribal natural resource agencies, fishing groups, environmental organizations, conservation organizations, and individuals with expertise in Pacific salmonids. The vast majority of respondents supported listing Puget Sound steelhead under the ESA. We also received comments from four of the independent experts from whom we had requested technical review of the scientific information underlying the March 2006 proposed listing determination. Copies of the full text of comments received are available upon request (see **ADDRESSES** and **FOR FURTHER INFORMATION CONTACT**).

Below we address the comments received that pertain to the listing determination for Puget Sound steelhead. The issues raised and our responses are organized into six general categories: (1) General Comments; (2) Comments on the Consideration of Hatchery Steelhead; (3) Comments on the Consideration of Resident *O. mykiss*; (4) Comments on the Assessment of Extinction Risk; (5) Comments on the Factors Affecting the Species; and (6) Comments on the Consideration of Protective Efforts/Mitigating Factors.

General Comments and Comments on Process

Comment 1: Most commenters supported listing Puget Sound steelhead under the ESA, and many expressed concern over the species' decline and the potential impacts of that decline on business and recreation. Some comments expressed concern over the fact that the current status review for Puget Sound steelhead was completed only 10 years after the previous review which found that a listing determination was not warranted.

Response: The BRT status review describes the various types of new information that are available since the review by Busby *et al.* (1996). In addition, there have been considerable scientific findings and policy development regarding the role of resident and hatchery *O. mykiss* in steelhead DPSs (see 70 FR 37204, June 28, 2005; 70 FR 67131, November 4, 2005; 71 FR 834, January 5, 2006). All of these considerations have been factored into this updated status review and support our determination that

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 226

[Docket No. 030716175-5203-04; I.D. No. 070303A]

RIN 0648-AQ77

Endangered and Threatened Species; Designation of Critical Habitat for 12 Evolutionarily Significant Units of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration, Commerce.

ACTION: Final rule.

SUMMARY: We, the National Marine Fisheries Service (NMFS), are issuing a final rule designating critical habitat for 12 Evolutionarily Significant Units (ESUs) of West Coast salmon (chum, *Oncorhynchus keta*; sockeye, *O. nerka*; chinook, *O. tshawytscha*) and steelhead (*O. mykiss*) listed as of the date of this designation under the Endangered Species Act of 1973, as amended (ESA). The specific areas designated in the rule text set out below include approximately 20,630 mi (33,201 km) of lake, riverine, and estuarine habitat in Washington, Oregon, and Idaho, as well as approximately 2,312 mi (3,721 km) of marine nearshore habitat in Puget Sound, Washington. Some of the areas designated are occupied by two or more ESUs. The annual net economic impacts of changes to Federal activities as a result of critical habitat designation (regardless of whether those activities would also change as a result of the ESA's jeopardy requirement) are estimated to be approximately \$201.2 million. Fish and wildlife conservation actions for the Federal Columbia River Power System and other major hydropower projects in the Pacific Northwest are expected to generate another \$500-700 million in annual costs, including forgone power revenues. While these hydropower projects are covered by ESA section 7, the conservation actions that generate these costs are imposed by a wide variety of laws. We solicited information and comments from the public in an Advance Notice of Proposed Rulemaking (ANPR) and on all aspects of the proposed rule. This rule is being issued to meet the timeline established in litigation between NMFS and Pacific Coast Federation of Fishermen's Associations (*PCFFA et. al*

v. NMFS (Civ. No. 03-1883)). In the proposed rule, we identified a number of potential exclusions we were considering including exclusions for federal lands subject to the Pacific Northwest Forest Plan, PACFISH and INFISH. We are continuing to analyze whether exclusion of those federal lands is appropriate.

DATES: This rule becomes effective January 2, 2006.

ADDRESSES: Comments and materials received, as well as supporting documentation used in the preparation of this final rule, are available for public inspection by appointment, during normal business hours, at the National Marine Fisheries Service, NMFS, Protected Resources Division, 1201 NE Lloyd Blvd., Suite 1100, Portland, OR 97232-1274. The final rule, maps, and other materials relating to these designations can be found on our website at <http://www.nwr.noaa.gov/1salmon/salmesa/crithab/CHsite.htm>.

FOR FURTHER INFORMATION CONTACT: Steve Stone at the above address, at (503) 231-2317, or Marta Nammack at (301) 713-1401 ext. 180.

SUPPLEMENTARY INFORMATION:**Organization of the Final Rule**

This **Federal Register** notice describes the final critical habitat designations for 12 ESUs of West Coast salmon and steelhead under the ESA. The pages that follow summarize the comments and information received in response to proposed designations published on December 14, 2004 (69 FR 74572), describe any changes from the proposed designations, and detail the final designations for 12 ESUs. To assist the reader, the content of this document is organized as follows:

- I. Background and Previous Federal Action
- II. Summary of Comments and Recommendations
 - Notification and General Comments*
 - Identification of Critical Habitat Areas*
 - Economics Methodology*
 - Weighing the Benefits of Designation vs. Exclusion*
 - Effects of Designating Critical Habitat ESU-Specific Issues*
- III. Summary of Revisions
- IV. Methods and Criteria Used To Identify Critical Habitat
 - Salmon Life History*
 - Identifying the Geographical Area Occupied by the Species and Specific Areas Within the Geographical Area*
 - Primary Constituent Elements (PCEs)*
 - Special Management Considerations or Protections*
 - Unoccupied Areas*
 - Lateral Extent of Critical Habitat*
 - Military Lands*
 - Critical Habitat Analytical Review Teams*
- V. Application of ESA Section 4(b)(2)

*Exclusions Based on "Other Relevant Impacts"**Impacts to Tribes**Impacts to Landowners With Contractual Commitments to Conservation**Exclusions Based on National Security Impacts**Exclusions Based on Economic Impacts*

VI. Critical Habitat Designation

VII. Effects of Critical Habitat Designation

*Section 7 Consultation**Activities Affected by Critical Habitat Designation*

VIII. Required Determinations

IX. References Cited

I. Background and Previous Federal Action

We are responsible for determining whether species, subspecies, or distinct population segments of West Coast salmon and steelhead (*Oncorhynchus* spp.) are threatened or endangered, and for designating critical habitat for them under the ESA (16 U.S.C. 1531 *et seq.*). To qualify as a distinct population segment, a West Coast salmon or steelhead population must be substantially reproductively isolated from other conspecific populations and represent an important component in the evolutionary legacy of the biological species. According to agency policy, a population meeting these criteria is considered to be an Evolutionarily Significant Unit (ESU) (56 FR 58612; November 20, 1991).

We are also responsible for designating critical habitat for species listed under our jurisdiction. Section 3 of the ESA defines critical habitat as (1) specific areas within the geographical area occupied by the species at the time of listing, on which are found those physical or biological features that are essential to the conservation of the listed species and that may require special management considerations or protection, and (2) specific areas outside the geographical area occupied by the species at the time of listing that are essential for the conservation of a listed species. Our regulations direct us to focus on "primary constituent elements," or PCEs, in identifying these physical or biological features. Section 7(a)(2) of the ESA requires that each Federal agency shall, in consultation with and with the assistance of NMFS, ensure that any action authorized, funded or carried out by such agency is not likely to jeopardize the continued existence of an endangered or threatened salmon or steelhead ESU or result in the destruction or adverse modification of critical habitat. Section 4 of the ESA requires us to consider the economic impacts, impacts on national security, and other relevant impacts of

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Parts 223 and 224

[Docket No. 990303060-9071-02; I.D. 022398C]

RIN 0648-AM54

Endangered and Threatened Species; Threatened Status for Three Chinook Salmon Evolutionarily Significant Units (ESUs) in Washington and Oregon, and Endangered Status for One Chinook Salmon ESU in Washington

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Final rule.

SUMMARY: NMFS is issuing final determinations to list four ESUs of west coast chinook salmon as threatened or endangered species under the Endangered Species Act (ESA) of 1973, as amended. Previously, NMFS completed a comprehensive status review of west coast chinook salmon (*Oncorhynchus tshawytscha*) which resulted in proposed listings for eight ESUs. After reviewing additional information, including biological data on the species' status and an assessment of protective efforts, NMFS now concludes that four chinook salmon ESUs warrant protection under the ESA. NMFS has determined that Puget Sound chinook salmon in Washington, Lower Columbia River chinook salmon in Washington and Oregon, and Upper Willamette spring-run chinook salmon in Oregon are at risk of becoming endangered in the foreseeable future and will be listed as threatened species under the ESA. NMFS also has determined that Upper Columbia River spring-run chinook salmon in Washington are in danger of extinction throughout all or a significant portion of their range and will be listed as an endangered species.

With respect to the Central Valley spring-run, Central Valley fall/late fall-run, and Southern Oregon and California Coastal chinook salmon ESUs proposed for listing, NMFS has found that substantial scientific disagreement precludes making final determinations and has extended the deadline for an additional 6 months to resolve these disagreements. Similarly, the proposed revision of the currently listed Snake River fall-run chinook salmon ESU to include fall-run chinook salmon in the Deschutes River, Oregon, is still under review in order to resolve substantial

scientific disagreements about the information relevant to that determination. The findings regarding substantial scientific disagreement and extension of final determination for the 4 chinook salmon ESUs published in the Proposed Rules section in this **Federal Register** issue.

DATES: Effective May 24, 1999.

ADDRESSES: Branch Chief, NMFS, Northwest Region, Protected Resources Division, 525 N.E. Oregon St., Suite 500, Portland, OR 97232-2737; Salmon Coordinator, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910.

FOR FURTHER INFORMATION CONTACT: Garth Griffin at (503) 231-2005, or Chris Mobley at (301) 713-1401.

SUPPLEMENTARY INFORMATION:**Previous Federal Actions**

West coast chinook salmon have been the subject of many Federal ESA actions, which are summarized in the proposed rule (63 FR 11482, March 9, 1998). NMFS initially announced its intention to conduct a coastwide review of chinook salmon status in response to a petition to list several Puget Sound chinook salmon stocks on September 12, 1994 (59 FR 46808). After receiving a more comprehensive petition from the Oregon Natural Resources Council and Dr. Richard Nawa on February 1, 1995, NMFS reconfirmed its intention to conduct a coastwide review (60 FR 30263, June 8, 1995). During that review, NMFS requested public comment and assessed the best available scientific and commercial data, including technical information from Pacific Salmon Biological Technical Committees (PSBTCs) and other interested parties. The PSBTCs consisted primarily of scientists (from Federal, state, and local resource agencies, Indian tribes, industries, universities, professional societies, and public interest groups) possessing technical expertise relevant to chinook salmon and their habitats. The NMFS Biological Review Team (BRT), composed of staff from NMFS' Northwest, Southwest, and Auke Bay Fisheries Science Centers, as well as from the National Biological Survey, reviewed and evaluated scientific information provided by the PSBTCs and other sources. Early drafts of the BRT review were distributed to state and tribal fisheries managers and peer reviewers who are experts in the field to ensure that NMFS' evaluation was accurate and complete. The BRT then incorporated tribal and state co-manager comments into the coastwide chinook salmon status review.

Based on the results of the completed status report on west coast chinook salmon (Myers *et al.*, 1998), NMFS has identified fifteen ESUs of chinook salmon from Washington, Oregon, Idaho, and California, including 11 new ESUs, and one redefined ESU (63 FR 11482, March 9, 1998). After assessing information concerning chinook salmon abundance, distribution, population trends, and risks, and after considering efforts being made to protect chinook salmon, NMFS determined that several chinook salmon ESUs did not warrant listing under the ESA. The chinook salmon ESUs not requiring ESA protection included the Upper Klamath and Trinity River ESU, Oregon Coast ESU, Washington Coast ESU, Middle Columbia River spring-run ESU, and Upper Columbia River summer/fall-run ESU.

Also based on this evaluation, and after considering efforts being made to protect chinook salmon, NMFS proposed that seven chinook salmon ESUs warranted listing as either endangered or threatened species under the ESA. The chinook salmon ESUs proposed as endangered species included California Central Valley spring-run and Washington's Upper Columbia River spring-run chinook salmon. The chinook salmon ESUs proposed as threatened species included California Central Valley fall/late fall-run, Southern Oregon and California Coastal, Puget Sound, Lower Columbia River, and Upper Willamette River spring-run chinook salmon. Additionally, NMFS found that fall-run chinook salmon from the Deschutes River in Oregon shared a strong genetic and life history affinity to currently listed Snake River fall-run chinook. Based on this affinity, NMFS proposed to revise the existing listed Snake River fall-run ESU to include fall-run chinook salmon in the Deschutes River. The resulting revised ESU would be listed as threatened.

During the year between the proposed rule and this final determination, NMFS conducted 21 public hearings within the range of the proposed chinook salmon ESUs in California, Oregon, Washington and Idaho. NMFS accepted and reviewed public comments solicited during a 112-day public comment period. Based on these public hearings, comments, and additional technical meetings with Indian tribes and the states, NMFS has found that substantial scientific disagreements exist concerning the information relevant to making final determinations for California's Central Valley spring-run and Central Valley fall/late fall-run, Southern Oregon and California Coastal,

Technical Report 2006-06



Juvenile Pacific Salmon in Puget Sound

Prepared in support of the Puget Sound Nearshore Partnership

Kurt L. Fresh

NOAA Fisheries Service
Northwest Fisheries Science Center



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Executive Summary

Puget Sound salmon (genus *Oncorhynchus*) spawn in freshwater and feed, grow and mature in marine waters. During their transition from freshwater to saltwater, juvenile salmon occupy nearshore ecosystems in Puget Sound. This period of nearshore residence is critical to the viability, persistence and abundance of Puget Sound salmon. Thus, restoring and protecting nearshore habitats important to juvenile salmon must be a part of efforts to rebuild depleted salmon runs throughout this region. The primary objective of this report is to summarize what we know about salmon use of nearshore habitats to help protect and restore these habitats.

Five species of Pacific salmon spawn and rear in Puget Sound. Use of nearshore ecosystems varies considerably between and within species. The concept that not all salmon use nearshore ecosystems in the same way is fundamental to the planning, implementation and monitoring of protection and restoration actions directed at salmon. This report focuses on naturally produced juvenile Chinook salmon and juvenile chum salmon, because these two species make the most extensive use of nearshore habitats.

For each species of salmon, use of nearshore habitats varies with scale. Two important scales of variation in habitat use are population (i.e., within species) and life history strategy (i.e., within population). Populations are subspecies units that refer to geographically discrete, semi-isolated breeding units of salmon. Populations differ in their use of nearshore habitats because of the specific conditions (e.g., differences in flow regimes, temperature regimes and migration distances) each encounters.

Populations are aggregated by the National Oceanic and Atmospheric Administration (NOAA) Fisheries into groups called Evolutionarily Significant Units (ESUs) that are used to make decisions about status under the Endangered Species Act (ESA). Two groups of Puget Sound salmon populations were listed as threatened under the ESA. The 22 populations of Chinook salmon spawning within Puget Sound east of the Elwha River were grouped into one ESU and listed as threatened in 1999. In addition, two populations (consisting of eight sub-populations) of chum salmon spawning in Hood Canal and the eastern Strait of Juan de Fuca during the summer and early fall (termed summer chum) were also grouped into an ESU and listed as threatened in 1999.

The second scale of variability important to understanding juvenile salmon use of nearshore ecosystems is the life history strategy of the fish. Individuals within a population vary in habitat use, based upon such factors as where they come from within the watershed, spawning timing, climate and abundance. Although life history variation occurs along a continuum, individuals within a salmon population can be aggregated into a more discrete number of life history strategies. In Puget Sound, juvenile Chinook salmon

have been aggregated into four general life history strategies, referred to as migrant fry, delta fry migrants, parr migrants, and yearlings, based upon when the fish leave freshwater and their size at this time.

The first juvenile Chinook salmon to arrive in estuaries are fry (< 50 mm fork length [FL]), which enter natal deltas between December and April. Some of the fry pass quickly through the natal delta (the migrant fry strategy) and enter Puget Sound, spending only days in natal deltas. Other fry (the delta fry strategy) remain in natal deltas for extended periods of up to 120 days, where they make extensive use of small (1st or 2nd order), dendritic tidal channels (channels that end in the upper end of the marsh) and sloughs in tidal wetlands.

During the late spring, fish associated with two other life history strategies (parr migrant and yearling) leave freshwater rearing habitats and migrate downstream to the estuary. Most parr migrants and yearlings arrive in the delta from May to mid-July. Residence time and migration timing from the natal delta into Puget Sound habitats are a function of a number of factors. In particular, with the exception of the migrant fry strategy, fish size at the time the fish arrive in the delta and residence time in the delta tend to be inversely related. Environmental conditions, especially increasing water temperatures, may also be an important determinant of when juvenile Chinook salmon leave delta habitats.

Once juvenile Chinook salmon leave estuarine/delta habitats and enter Puget Sound, they distribute widely throughout nearshore ecosystems. Their abundance in shoreline areas of Puget Sound typically peaks in June and July, although some are still present in shoreline habitats through at least October. As the fish increase in size, the depth of the water and diversity of habitats they use change. Optimal conditions for smaller juvenile Chinook salmon (< 70 mm) in estuarine areas appear to be low gradient, shallow water, fine-grained substrates (silts and mud), low salinity, and low wave energy. As they grow, juvenile Chinook salmon use a greater diversity of Puget Sound habitats including deeper, more offshore habitats, and eventually, most fish leave for North Pacific Ocean feeding grounds.

Within Puget Sound watersheds, we have not yet identified discrete life history strategies for chum salmon populations. Most chum salmon fry leave freshwater within one or two days of emergence, which can occur as early as December. These early emerging fish are likely summer run chum salmon, with later emerging members belonging to other races. Most available information on chum salmon does not distinguish use based upon race (i.e., it is not specific to summer chum salmon). The timing of when chum salmon enter nearshore ecosystems should affect some aspects of habitat use such as diet, residence time, growth rates and so

on, simply because the condition of nearshore ecosystems is not the same for early and late migrants.

Chum salmon fry can either pass directly through natal estuaries into Puget Sound, or they can rear for weeks in estuarine habitats before moving into shoreline areas. Juvenile chum salmon often occur in non-natal estuaries. Migration rates of chum salmon in nearshore areas depend upon such factors as fish size, foraging success and environmental conditions (currents). Habitat use appears to be strongly size dependent. Small chum salmon fry (< 50-60 mm) tend to migrate along the shoreline in shallow water, < 2 meters in depth. As chum salmon fry increase in size to > 60 mm, they expand the habitats they use to include nearshore surface waters. Chum salmon abundance in nearshore areas peaks in May and June. Abundance after June declines significantly as chum salmon move farther offshore and migrate out of Puget Sound, although some are still found in nearshore areas through October.

The ability of nearshore ecosystems to support or promote salmon population viability is a function of the biological, physical and chemical characteristics of the habitats used by juvenile salmon. Habitat function depends upon both local attributes and the context of that habitat within the bigger picture of its surrounding larger ecological systems (referred to as landscape attributes); landscape attributes include the arrangement of habitats, habitat shape, location and connectivity. The ability of nearshore habitats to support salmon population viability is a function of how well the habitat supports: 1) feeding and growth, 2) avoidance of predators, 3) the physiological transition from freshwater to saltwater, and 4) migration to ocean feeding habitats. In general, our ability to quantitatively or conceptually link nearshore habitat characteristics to functions of that habitat for juvenile salmon (i.e., salmon performance) varies considerably with

species and habitat type. This reflects the complexity of the salmon life cycle and the fact that the habitat requirements of salmon can vary broadly as a function of many factors, including specific location of the habitat, time of year, species, population, size of salmon, and life history strategy. For example, our ability to link nearshore habitat characteristics to functions that support juvenile Chinook salmon is strongest in natal deltas and weakest along shorelines.

Humans can impact the functioning of nearshore habitats for juvenile salmon in many ways. A Conceptual Model developed by the Nearshore Science Team (Simenstad et al. 2006) was used to explore the relationships between human actions (including restoration actions), ecosystem processes, habitat and function (in this case support of juvenile salmon). Lessons learned from applying this conceptual model to several scenarios involving juvenile salmon revealed that a scenario needs to be created that answers a number of questions:

1. What species, life history strategy, and size class is being considered?
2. What habitat type is being affected (e.g., eelgrass bed vs. tidal channel)?
3. Where in Puget Sound is the action occurring?
4. What type of action is being considered (e.g., dike breaching vs. armoring)?
5. What constraints, such as geomorphologic context, exist?

If such scenarios can be devised, then we can more directly explore how an action may affect salmon population viability, identify possible outcomes of an action, define key uncertainties, and help assess potential risks.



Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead

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June 2005

U.S. DEPARTMENT OF COMMERCE

Carlos M. Gutierrez, Secretary

National Oceanic and Atmospheric Administration

Vice Admiral Conrad C. Lautenbacher, Jr. USN (Ret), Administrator

National Marine Fisheries Service

William T. Hogarth, Assistant Administrator for Fisheries

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Executive Summary

During the 1990s, the National Marine Fisheries Service (NMFS or NOAA Fisheries Service) conducted a series of reviews of the status of West Coast populations of Pacific salmon and steelhead (*Oncorhynchus* spp.) with respect to the U.S. Endangered Species Act (ESA). This technical memorandum summarizes scientific conclusions of the NMFS Biological Review Teams (BRTs) regarding the updated status of 26 ESA-listed ESUs (evolutionarily significant units) of salmon and steelhead (and one candidate species ESU) from Washington, Oregon, Idaho, and California. These ESUs were listed following a series of status reviews conducted during the 1990s. The status review updates were undertaken to allow consideration of new data that accumulated over the various time periods since the last updates and to address issues raised in recent court cases [*Alsea Valley Alliance v. Evans*, 161 F. Supp. 2d 1154, D. Ore. 2001, and *EDC v. Evans*, SACV-00-1212-AHS (EEA); *MID v. Evans*, CIV-F-02-6553 OWW DLB (E.D. Cal)] regarding the ESA status of hatchery fish and resident (nonanadromous) populations.

This technical memorandum represents the first major step in the agency's efforts to review and update the listing determinations for all listed ESUs of salmon and steelhead. By statute, ESA listing determinations must consider not only the best scientific information available but also those efforts being made to protect the species. After receiving the BRT report and considering the conservation benefits of protective efforts, NMFS will determine what changes, if any, to propose to the listing status of the affected ESUs.

As in the past, the BRTs used a risk-matrix method to quantify risks in different categories within each ESU. In the current report, the method was modified to reflect the four major criteria identified in the NMFS viable salmonid populations (VSPs) document (McElhany et al. 2000): abundance, growth rate/productivity, spatial structure, and diversity. These criteria are used as a framework for approaching formal ESA recovery planning for salmon and steelhead. Tabulating mean risk scores for each element allowed the BRTs to identify the most important concerns for each ESU and to compare relative risk across ESUs and species. The BRTs considered these data and other information in making their overall risk assessments. Based on provisions in a draft of the revised NMFS policy on consideration of artificial propagation in salmon listing determinations, each BRT's risk analysis focused on the viability of populations sustained by natural production.

Based on the criterion of self-sustainability, for the following ESUs the majority BRT conclusion was "in danger of extinction:" Upper Columbia River spring-run Chinook (*Oncorhynchus tshawytscha*), Sacramento River winter-run Chinook, Upper Columbia River steelhead (*O. mykiss*), Southern California steelhead, California Central Valley steelhead, Central California Coast coho (*O. kisutch*), Lower Columbia River coho, Snake River sockeye (*O. nerka*). For the following ESUs, the majority BRT conclusion was "likely to become endangered in the foreseeable future:" Snake River fall-run Chinook, Snake River spring/summer-run Chinook, Puget Sound Chinook, Lower Columbia River Chinook, Upper Willamette River Chinook, California Coastal Chinook, Central Valley spring-run Chinook,

Snake River steelhead, Lower Columbia River steelhead, Upper Willamette River steelhead, Northern California steelhead, Central California Coast steelhead, South-Central California Coast steelhead, Oregon Coast coho, Southern Oregon/Northern California Coasts coho, Ozette Lake sockeye, Hood Canal summer-run chum, and Lower Columbia River chum. In one case (Middle Columbia River steelhead), the BRT was nearly evenly split on the question of whether the ESU was likely to become endangered in the foreseeable future (a slight majority concluded that the ESU was likely to become endangered) (Table ES-1).

Table ES-1. BRT conclusions regarding updated status of salmon and steelhead ESUs. X = the majority vote. (X) = a substantial minority (>40% of the vote).

Species	ESU	Danger of extinction	Likely to become endangered	Not likely to become endangered
Chinook	Snake River fall run	—	X	—
	Snake River spring/summer run	—	X	—
	Upper Columbia River spring run	X	(X)	—
	Puget Sound	—	X	—
	Lower Columbia	—	X	—
	Upper Willamette	—	X	—
	California Coastal	—	X	—
	Sacramento River winter run	X	—	—
	Central Valley spring run	—	X	—
Steelhead	Snake River Basin	—	X	—
	Upper Columbia River	X	(X)	—
	Middle Columbia River	—	X	(X)
	Lower Columbia River	—	X	—
	Upper Willamette River	—	X	—
	Northern California	—	X	—
	Central California Coast	—	X	—
	South-Central California Coast	—	X	—
	Southern California	X	—	—
	California Central Valley	X	—	—
Coho	Oregon Coast	—	X	(X)
	Southern Oregon/Northern California Coasts	—	X	—
	Central California	X	—	—
	Lower Columbia	X	—	—
Sockeye	Snake River	X	—	—
	Ozette Lake	—	X	—
Chum	Hood Canal summer run	—	X	—
	Columbia River	—	X	—

7. Puget Sound Chinook Salmon ESU

The status of Puget Sound Chinook salmon was formally assessed during a coastwide status review (Myers et al. 1998). In November 1998, a BRT was convened to update the status of this ESU by summarizing information received since that review and comments on the 1997 status review (NMFS 1998a). The subsection below, Summary of Previous BRT Conclusions, summarizes findings and conclusions made at the time of the 1998 status review update; New Data and Updated Analyses reports on new information received through March 2003 and the 2003 BRT's conclusions, based on the new information.

Summary of Previous BRT Conclusions

Status and Trends

The BRT concluded in 1998 that the Puget Sound Chinook salmon ESU was likely to become endangered in the foreseeable future. The estimated total run size of Chinook salmon to Puget Sound in the early 1990s was 240,000 Chinook, down from an estimated 690,000 historical run size. The 5-year geometric mean of spawning escapement of natural Chinook salmon runs in north Puget Sound during the period from 1992 to 1996 was approximately 13,000. Both long- and short-term trends for these runs were negative, with few exceptions. In south Puget Sound, spawning escapement of the natural runs averaged 11,000 spawners at the time of the last status review update. In this area, both long- and short-term trends were predominantly positive. In Hood Canal, spawning populations in six streams were considered a single stock by the comanagers because of extensive transfers of hatchery fish (WDF et al. 1993). Fisheries in the area were managed primarily for hatchery production and secondarily for natural escapement; high harvest rates directed at hatchery stocks resulted in failure to meet natural escapement goals in most years (USFWS 1997).

The 5-year geometric mean natural spawning escapement at the time of the last update was 1,100, with negative short- and long-term trends (except in the Dosewallips River). The ESU also includes the Dungeness and Elwha rivers, which have natural Chinook salmon runs as well as hatchery runs. The Dungeness River had a run of spring- and summer-run Chinook salmon, with a 5-year geometric mean natural escapement of 105 fish at the time of the last status review update. The Elwha River had a 5-year geometric mean escapement of 1,800 fish during the mid-1990s, which includes a large, but unknown fraction of naturally spawning hatchery fish. Both the Elwha and Dungeness river populations exhibited downward trends in abundance in the 1990s.

Threats

Habitat throughout the ESU has been blocked or degraded. In general, forest practices impacted upper tributaries, and agriculture or urbanization impacted lower tributaries and mainstem rivers. WDF et al. (1993) cited diking for flood control, draining and filling of freshwater and estuarine wetlands, and sedimentation due to forest practices and urban development as problems throughout the ESU. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in several basins. Bishop and Morgan (1996) identified a variety of critical habitat issues for streams in the range of this ESU, including changes in flow regime (all basins), sedimentation (all basins), high temperatures (Dungeness, Elwha, Green/Duwamish, Skagit, Snohomish, and Stillaguamish rivers), streambed instability (most basins), estuarine loss (most basins), loss of large woody debris (Elwha, Snohomish, and White rivers), loss of pool habitat (Nooksack, Snohomish, and Stillaguamish rivers), and blockage or passage problems associated with dams or other structures (Cedar, Elwha, Green/Duwamish, Snohomish, and White rivers).

The Puget Sound Salmon Stock Review Group of the Pacific Fishery Management Council (PFMC 1997a) provided an extensive review of habitat conditions for several stocks in this ESU. It concluded that reductions in habitat capacity and quality have contributed to escapement problems for Puget Sound Chinook salmon, citing evidence of direct losses of tributary and mainstem habitat due to dams, and of slough and side-channel habitat due to diking, dredging, and hydromodification. It also cited reductions in habitat quality due to land management activities.

WDF et al. (1993) classified 11 out of 29 stocks in this ESU as being sustained, in part, through artificial propagation. Nearly 2 billion fish have been released into Puget Sound tributaries since the 1950s (Myers et al. 1998). The vast majority of these fish were derived from local returning fall-run adults. Returns to hatcheries have accounted for 57% of total spawning escapement, although the hatchery contribution to spawner escapement is probably much higher than that, due to hatchery-derived strays on the spawning grounds. Almost all releases into this ESU have come from stocks within this ESU, with the majority of within-ESU transfers coming from the Green River Hatchery or hatchery broodstocks derived from Green River stock (Marshall et al. 1995). The electrophoretic similarity between Green River fall-run Chinook salmon and several other fall-run stocks in Puget Sound (Marshall et al. 1995) suggests that there may have been a significant effect from some hatchery transplants. Overall, the pervasive use of Green River stock throughout much of the extensive hatchery network that exists in this ESU may reduce the genetic diversity and fitness of naturally spawning populations.

Harvest impacts on Puget Sound Chinook salmon stocks were quite high. Ocean exploitation rates on natural stocks averaged 56–59%; total exploitation rates averaged 68–83% (1982–1989 broodyears) (PSC 1994). Total exploitation rates on some stocks have exceeded 90% (PSC 1994).

Previous assessments of stocks within this ESU identified several stocks as being at risk or of concern (reviewed in Myers et al. 1998).

Listing status: Threatened.

New Data and Updated Analyses

ESU Status at a Glance

Historical peak run size	≈690,000
Historical populations	31
Extant populations	22
5-year geometric mean natural spawners per population	222–9,489 (median = 766)
Long-term trend per population	0.92–1.2 (median = 1.0)
Recent λ (H1) per population	0.67–1.2 (median = 1.0)

ESU Structure

The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, 22 of which are believed to be extant currently (Puget Sound TRT 2001, 2002). The populations presumed to be extinct are mostly early returning fish; most of these are in mid- to southern Puget Sound or Hood Canal and the Strait of Juan de Fuca (Table 8). The ESU populations with the greatest estimated fractions of hatchery fish tend to be in mid- to southern Puget Sound, Hood Canal, and the Strait of Juan de Fuca (Table 9).

New information obtained for the 22 Chinook salmon populations in the Puget Sound ESU is summarized in Appendix A, Table A-2. Data sources and detailed information on data years are provided for each population separately in the appendix.

Abundance of Natural Spawners

The most recent 5-year (1998–2002) geometric mean of natural spawners in populations of Puget Sound Chinook salmon ranges from 222 (in the Dungeness River) to almost 9,500 fish (in the upper Skagit River population). Most populations contain natural spawners numbering in the high hundreds (median recent natural escapement = 766); and of the 10 populations with greater than 1,000 natural spawners, only 2 are thought to have a low fraction of hatchery fish (Table 9, Figures 32–53). Estimates of the fraction of natural spawners that are of hatchery origin are sparse—data are available for only 12 of the 22 populations in the ESU, and such information is available for only the most recent 5–10 years (Table 9). Estimates of the hatchery fraction of natural spawners come from counts of otolith-marked local hatchery fish sampled from carcasses (Nooksack River basin, Snohomish River basin), adipose fin-clip counts from redd count surveys (Skagit River basin), and coded-wire tag sampling (North Fork Stillaguamish and Green rivers). In general, populations in the Skagit River basin are the only ones with presumed low estimates of naturally spawning hatchery fish. The Stillaguamish and Snohomish populations have moderate estimates of naturally spawning hatchery fish. Estimates of historical equilibrium abundance from predicted pre-European settlement habitat conditions range from 1,700 to 51,000 potential Chinook salmon spawners per population (Mobrand 2000). The historical estimates of equilibrium abundance are several orders of magnitude higher than realized spawner abundances currently observed throughout the ESU.

Table 8. Historical populations of Chinook salmon in the Puget Sound ESU, run-timing types for each population, and each population's biogeographic region.

Population^a	Status	Run-timing^b	Bio-geographic region^b	Reference
North Fork Nooksack	Extant	Early	Strait of Georgia	–
South Fork Nooksack	Extant	Early	Strait of Georgia	–
Nooksack late	Extinct	Late	Strait of Georgia	Puget Sound TRT (2001)
Lower Skagit	Extant	Late	Whidbey Basin	–
Upper Skagit	Extant	Late	Whidbey Basin	–
Lower Sauk	Extant	Late	Whidbey Basin	–
Upper Sauk	Extant	Early	Whidbey Basin	–
Suiattle	Extant	Early	Whidbey Basin	–
Upper Cascade	Extant	Early	Whidbey Basin	–
North Fork Stillaguamish	Extant	Late	Whidbey Basin	–
South Fork Stillaguamish	Extant	Late	Whidbey Basin	–
Stillaguamish early	Extinct	Early	Whidbey Basin	Nehlsen et al. (1991), WDF et al. (1993)
Skykomish	Extant	Late	Whidbey Basin	–
Snoqualmie	Extant	Late	Whidbey Basin	–
Snohomish early	Extinct	Early	Whidbey Basin	Nehlsen et al. (1991), WDF et al. (1993)
Cedar	Extant	Late	Main/South Basins	–
North Lake Washington	Extant	Late	Main/South Basins	–
Green/Duwamish	Extant	Late	Main/South Basins	–
Green/Duwamish early	Extinct	Early	Main/South Basins	Nehlsen et al. (1991), WDF et al. (1993)
Puyallup	Extant	Late	Main/South Basins	–
White	Extant	Early	Main/South Basins	–
Puyallup early	Extinct	Early	Main/South Basins	Nehlsen et al. (1991)
Nisqually	Extant	Late	Main/South Basins	–
Nisqually early	Extinct	Early	Main/South Basins	Nehlsen et al. (1991), ONRC and Kawa (1995)
Skokomish	Extant	Late	Hood Canal	–
Skokomish early	Extinct	Early	Hood Canal	Nehlsen et al. (1991), WDF et al. (1993)
Dosewallips	Extant	Late	Hood Canal	–
Dosewallips early	Extinct	Early	Hood Canal	Nehlsen et al. (1991), ONRC and Kawa (1995)
Dungeness	Extant	Late	Strait of Juan de Fuca	–
Elwha	Extant	Late	Strait of Juan de Fuca	–
Elwha early	Extinct	Early	Strait of Juan de Fuca	Nehlsen et al. (1991)

^a Puget Sound Technical Recovery Team (2001).^b Puget Sound Technical Recovery Team (2001, 2002).

Table 9. Abundance of natural spawners, estimates of the fraction of hatchery fish in natural escapements, and estimates of historical capacity of Puget Sound streams. Sources: For data sources, see Appendix A, Table-2.

Population	Geometric mean natural spawners (1998–2002)	Arithmetic mean natural spawners (1998–2002) (minimum, maximum)	Geometric mean natural–origin spawners (1998–2002)	Average % hatchery fish in escapement^a 1997–2001 (min.–max. since 1992)	Chinook salmon hatcheries in basin	Hatchery fraction data? (years)	EDT estimate of historical abundance^b
North Fork Nooksack ^c	1,538	2,275 (366–4,671)	125	91 (88–95)	Kendall (NFH; RM 45)	Yes (1995–2002)	26,000
South Fork Nooksack ^c	338	372 (157–620)	197	40 (24–55)	Kendall (NFH; RM45)	Yes (1999–2002)	13,000
Lower Skagit	2,527	2,833 (1,043–4,866)	2,519	0.2 (0–0.7)	Marblemount (mouth of Cascade) ^d	Yes (1998–2001)	22,000
Upper Skagit	9,489	10,468 (3,586–13,815)	9,281	2 (2–3)	Marblemount (mouth of Cascade) ^d	Yes (1995–2000)	35,000
Upper Cascade	274	329 (83–625)	274	0.3	Marblemount (mouth of Cascade) ^d	No (assume low)	1,700
Lower Sauk	601	669 (295–1,103)	601	0	Marblemount (mouth of Cascade) ^d	Yes (2001)	7,800
Upper Sauk	324	349 (180–543)	324	0	Marblemount (mouth of Cascade) ^d	No (assumed)	4,200
Suiattle	365	399 (208–688)	365	0	Marblemount (mouth of Cascade) ^d	No (assumed)	830
North Fork Stillaguamish	1,154	1,172 (845–1,403)	671	40 (13–52)	Tribal (NF)	Yes (1988–1999)	24,000
South Fork Stillaguamish	270	272 (243–335)	NA	NA	Tribal (NF)	None	20,000
Skykomish	4,262	4,286 (3,455–4,665)	2,392	40 (11–66)	Wallace River	Yes (1979–2001)	51,000
Snoqualmie	2,067	2,229 (1,344–3,589)	1,700	16 (5–72)	Wallace River	Yes (1979–2001)	33,000
North Lake Washington	331	351 (227–537)	NA	NA	Lake Washington, Issaquah, University of Washington	None	NA
Cedar	327	394 (120–810)	NA	NA	Lake Washington, Issaquah, University of Washington	None	NA
Green	8,884	9,286 (6,170–13,950)	1,099	83 (35–100)	Soos, Icy, Keta creeks	Yes (1989–1997)	NA
White ^c	844	1,039 (316–2,002)	NA	NA	White River (RM 23); Voights Creek (Carbon River), Diru (RM 5)	None	NA

Table 9 continued. Abundance of natural spawners, estimates of the fraction of hatchery fish in natural escapements, and estimates of historical capacity of Puget Sound streams. Sources: For data sources, see Appendix A, Table-2.

Population	Geometric mean natural spawners (1998–2002)	Arithmetic mean natural spawners (1998–2002) (minimum, maximum)	Geometric mean natural–origin spawners (1998–2002)	Average % hatchery fish in escapement ^a 1997–2001 (min.–max. since 1992)	Chinook salmon hatcheries in basin	Hatchery fraction data? (years)	EDT estimate of historical abundance ^b
Puyallup	1,653	1,679 (1,193–1,988)	NA	NA	Voights Creek (Carbon River), Diru (RM 5)	None	33,000
Nisqually	1,195	1,221 (834–1,542)	NA	NA	Kalama, Clear Creek	None	18,000
Skokomish	1,392	1,437 (926–1,913)	NA	NA	George Adams (Purdy Creek, lower Skok)	None	NA
Dosewallips ^f	48	50 (29–65)	NA	NA	None	None	4,700
Duckabush ^f	43	57 (20–151)	NA	NA	None	None	NA
Hamma Hamma ^f	196	278 (32–557)	NA	NA	None	None	NA
Mid Hood Canal	311	381 (95–762)	NA	NA	None	None	NA
Dungeness ^e	222	304 (75–663)	NA	NA	Dungeness (and Hurd Creek)	None	8,100
Elwha ^{g, h}	688	691 (633–813)	NA	NA	Tribal (RM 1) and state (RM 3.2)	None	NA

NFH = National Fish Hatchery.

^a Estimates of the fraction of hatchery fish in natural spawning escapements are from the Puget Sound TRT database; Green River estimates are from Alexandersdottir (2001).

^b Estimates of historical equilibrium abundance based on an EDT analysis conducted by the comanagers in Puget Sound (Puget Sound TRT 2002).

^c North Fork Nooksack natural escapement counts include estimated numbers of spawners from the Middle Fork Nooksack River since the late 1990s and Chinook salmon returning to the North Fork hatchery that were released back into the North Fork to spawn; South Fork Nooksack natural escapement estimates contain naturally spawning hatchery fish from the early run and late-run hatchery programs in the Nooksack River basin.

^d Previous summer-run Chinook salmon hatchery program discontinued—last returns in 1996; current summer-run program (initiated in 1994) collects hatchery broodstock from spawners in upper Skagit River.

^e Captive broodstock program for early run Chinook salmon ended in 2000; estimates of natural spawning escapement include an unknown fraction of naturally spawning hatchery-origin fish from late- and early run hatchery programs in the White and Puyallup River basins.

^f The Puget Sound TRT considers Chinook salmon spawning in the Dosewallips, Duckabush, and Hamma Hamma rivers to be subpopulations of the same historically independent population; annual counts in those three streams are variable due to inconsistent visibility during spawning ground surveys.

^g Year 2002 natural escapement data are not available.

^h Estimates of natural escapement do not include volitional returns to the hatchery or those fish gaffed or seined from spawning grounds for broodstock collection.



Status Review of Puget Sound Steelhead (*Oncorhynchus mykiss*)

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Steelhead tend to spawn in moderate to high gradient sections of streams. In contrast to semelparous Pacific salmon, steelhead females do not guard their redds, or nests, but return to the ocean following spawning (Burgner et al. 1992). Spawned out females that return to the sea are referred to as “kelts.”

Summer Run Steelhead

The life history of summer run steelhead is highly adapted to specific environmental conditions. Because these conditions are not common in Puget Sound, the relative incidence and size of summer run steelhead populations is substantially less than that for winter run steelhead. Summer run steelhead also have not been widely monitored, in part, because of their small population size and the difficulties in monitoring fish in their headwater holding areas. Sufficient information exists for only 4 of the 16 Puget Sound summer run steelhead populations identified in the 2002 Salmonid Stock Inventory (SaSI) to determine the population status (WDFW 2002).

Juvenile Life History

The majority of steelhead juveniles reside in fresh water for 2 years prior to emigrating to marine habitats (Tables 2-4), with limited numbers emigrating as 1- or 3-year-old smolts. Smoltification and seaward migration occur principally from April to mid-May (WDF et al. 1972). Two-year-old naturally produced smolts are usually 140–160 mm in length (Wydoski and Whitney 1979, Burgner et al. 1992). The inshore migration pattern of steelhead in Puget Sound is not well understood; it is generally thought that steelhead smolts move quickly offshore (Hartt and Dell 1986).

Ocean Migration

Steelhead oceanic migration patterns are poorly understood. Evidence from tagging and genetic studies indicates Puget Sound steelhead travel to the central North Pacific Ocean (French et al. 1975, Hartt and Dell 1986, Burgner et al. 1992). Puget Sound steelhead feed in the ocean for 1 to 3 years before returning to their natal stream to spawn. Typically, Puget Sound steelhead spend 2 years in the ocean although, notably, Deer Creek summer run steelhead spend only a single year in the ocean before spawning (Tables 3 and 4).²

² Steelhead are typically aged from scales or otoliths based on the number of years spent in freshwater and salt water. For example, a 2/2 aged steelhead spent 2 years in fresh water prior to emigrating to the ocean where, after 2 years in the ocean, the fish returned to spawn.